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Macro-, Meso- and Micro-Scopic Metallo-Thermo-Mechanics

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Evolution of material structure, temperature and mechanical fields undergoing phase transformation are coupled each other as is termed metallo-thermo-mechanical coupling. Three kinds of approach from maro-, meso- and micro-scopic viewpoints are presented, in this paper, to determine the fields, and fundamental governing equations are briefly introduced in the framework of metallo-thermo-mechanics respectively based on the methods of finite element, phase field and molecular dynamics. Some examples of simulated results are illustrated: Quenching of gear wheel and Japanese sword as well as continuous casting by twin roll method by FEM and forging of billet and gear by FVM; cooled plate with induced stress and dendrite growth from molten state by PFM; and melting of a bar, crystallographic change in optical memory device and shape memory effect by MDM.

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